Braun-Blanquet reclassification of the *Cymbopogon–Themeda* Grassland in the Lichtenburg area, south-western Transvaal

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The vegetation data of the *Cymbopogon–Themeda* Grassland in the Lichtenburg area was reclassified by a numerical classification technique (TWINSPAN) and refined by applying Braun-Blanquet procedures. The results, which can be integrated with existing phytosociological classifications of the western Transvaal grassland, are summarized in two phytosociological tables where 12 communities or variants, variously grouped into larger, more comprehensive vegetation units, are identified. These plant communities are ecologically interpreted and described.

Die plantegroeidata van die *Cymbopogon–Themeda* grasveld in die Lichtenburg omgewing is deur 'n numeriese klassifikasietegniek (TWINSPAN), wat verder deur die Braun-Blanquet prosedure verfyn is, geklassifiseer. Die resultate, wat met bestaande fitososiologiese klassifikasies van die Wes-Transvaalse grasveld geïntegreer kan word, word saamgevat in twee tabelle waarin 12 plantgemeenskappe of variante geïdentifiseer word, wat in 'n verskeidenheid groter, meer omvattende plantegroei-eenhede gegroepeer kan word. Die plantgemeenskappe word ekologies geïnterpreteer en beskryf.

Keywords: Association Analysis, Braun-Blanquet procedures, classification, Cymbopogon–Themeda Grassland, Western Grassland Biome.

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Introduction

Morris (1973, 1976) classified the vegetation of the Lichtenburg area by Association Analysis, a monothetic-divisive classification technique (Lambert & Williams 1962; Williams & Lambert 1959). From the results he recognized 18 final groups, 12 of which contained relevés from the *Cymbopogon–Themeda* Grassland system and six (Association Analysis groups 1–4a) of which contained relevés from the Bankenveld Grassland system (Figure 1). The reclassification of the Bankenveld Grassland is reported elsewhere (Bezuidenhout *et al.*, in prep.). However, due to heterogeneity in certain groups, he discussed only the following nine groups:

4b Short *Stipagrostis uniplumis* Calcareous Grassland
5b *Elionurus muticus* Secondary Grassland
6a Tall *Stipagrostis uniplumis* Calcareous Grassland
7a *Cymbopogon plurinodis* Grassland
7b/c No name
8 *Elionurus muticus* Primary Grassland
9a *Acacia karroo* Savanna and Secondary *Cymbopogon plurinodis* Grassland
9b *Acacia karroo* Open Woodland
9c Drainage Basin *Acacia karroo* Open Woodland.

Although most of these groups were ecologically interpretable, some are quite heterogeneous in floristic composition and habitat characteristics and do not represent ecologically interpretable vegetation units.

Vegetation units derived from Association Analysis are often not reconcilable with units obtained from polythetic or Braun-Blanquet techniques. The inclusion of these units in comprehensive phytosociological studies is therefore difficult or impossible (Kooij *et al.* 1992). Coetzee and Werger (1975) showed that polythetic Braun-Blanquet analyses of floristic data result in ecologically more reliable vegetation units than those derived from monothetic techniques. Although Morris (1973, 1976) derived ecologically interpretable vegetation types from the results of the Association Analysis, reconciliation of this classification with the comprehensive phytosociological classification of the western Transvaal (Bezuidenhout 1993) is difficult due to major differences in the procedures applied. The original data set of Morris (1973) comprised the total floristic composition, with Braun-Blanquet cover-abundance values for all identifiable species in the sample plots.

Thus, in order to include Morris's *Cymbopogon–Themeda* Grassland data in the synthesis of the western Transvaal grassland, the data were reclassified by means of Braun-Blanquet procedures (Westhoff & Van der Maarel 1978). Kooij *et al.* (1991, 1992) used this procedure successfully to contribute towards a synthesis of the vegetation from the north-western Orange Free State, and Bezuidenhout *et al.* (in prep.) also applied it successfully to reclassify the Bankenveld vegetation in the Lichtenburg area. In this report the Braun-Blanquet classification of the *Cymbopogon–Themeda* Grassland in the Lichtenburg area is presented.

Study area

The study area of Morris (1973) is bounded by latitudes 26°00′ and 26°20′ south and longitudes 25°54′ and 26°22′ east. This study area is situated in the north-northwestern part of the area where Bezuidenhout (1993) is currently preparing a comprehensive synthesis of the vegetation of the western Transvaal (Figure 2). The study area comprises approximately 177 000 ha. A detailed description of the physical environment was given by Morris (1973, 1976) and is not presented here.

The *Cymbopogon–Themeda* Grassland is generally situated on the flat plains associated with volcanic lava and quartzite of the Ventersdorp Supergroup and Dwyka tillite of the Karoo Sequence to the east of Lichtenburg, with recent surface limestone

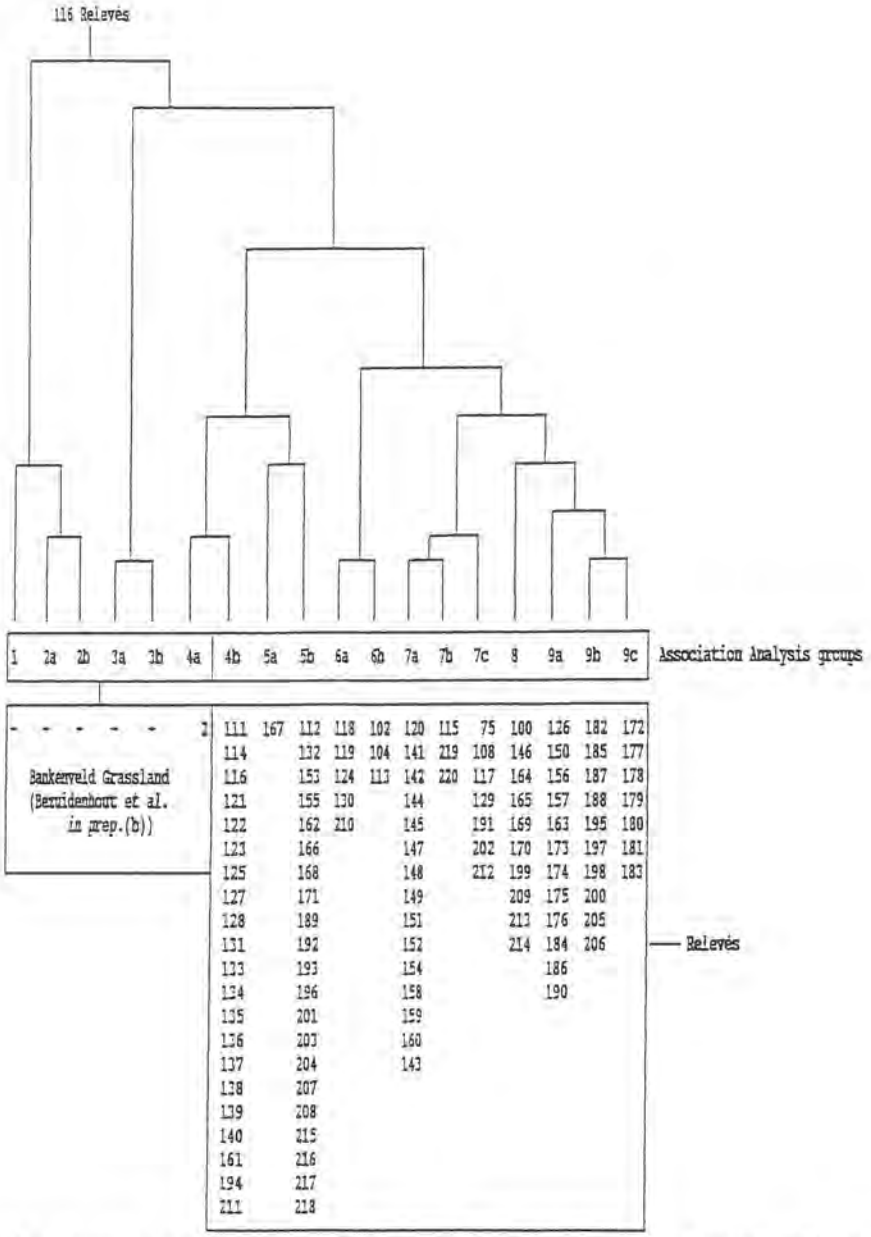


Figure 1 A dendrogram of the Association analysis of the *Cymbopogon–Themeda* Grassland (adapted from Morris 1973).

and aeolian sands to the west (Von Backström *et al.* 1953; Morris 1976).

Methods

The stratification of the study area by Morris (1973, 1976) was based on the Bankenveld and *Cymbopogon–Themeda* Grassland Land Systems (Mabbutt 1968), excluding all lands under cultivation, as well as the town of Lichtenburg and the bed of the Harts River. Relevés were compiled in 220 stratified random sample plots. The cover-abundance for each species present in the sample plots according to the Braun-Blanquet scale (Braun-Blanquet 1932), and limited habitat information, were noted in each sample plot of 16 m^2. More details were given by Morris (1973, 1976).

In the present study the classification algorithm TWINSPAN (Hill 1979) was used for analysing the total floristic data set (220 relevés), and subsequently Braun-Blanquet procedures were used to refine these results. Amongst others, these procedures were successfully used by Bezuidenhout (1988), Bezuidenhout *et al.* (1988), Behr and Bredenkamp (1988) and Bredenkamp *et al.* (1989).

Taxa names used in the plant community descriptions conform to those of Arnold and De Wet (1993). No attempt was made to formally fix syntaxa names, as this is normally avoided in detailed local studies (Coetzee 1983). The description of the soils is according to Macvicar *et al.* (1977).

A tabular comparison was made of the total association analysis classification and the Braun-Blanquet classification.

Results

The major division obtained by this procedure separates *Cymbopogon–Themeda* Grassland, consisting of 116 relevés, and Bankenveld, consisting of 104 relevés (Bezuidenhout *et al.*, in prep.). The *Cymbopogon–Themeda* Grassland, discussed in this paper, is clearly represented by two Major Grassland communities which are presented in two separate phytosociological tables (Tables 1 & 2) (Figure 3).

A. Braun-Blanquet classification

The vegetation of the *Cymbopogon–Themeda* Grassland on the flat plains in the Lichtenburg area can be described as a *Themeda triandra–Eragrostis curvula* Grassland. A feature of the vegeta-

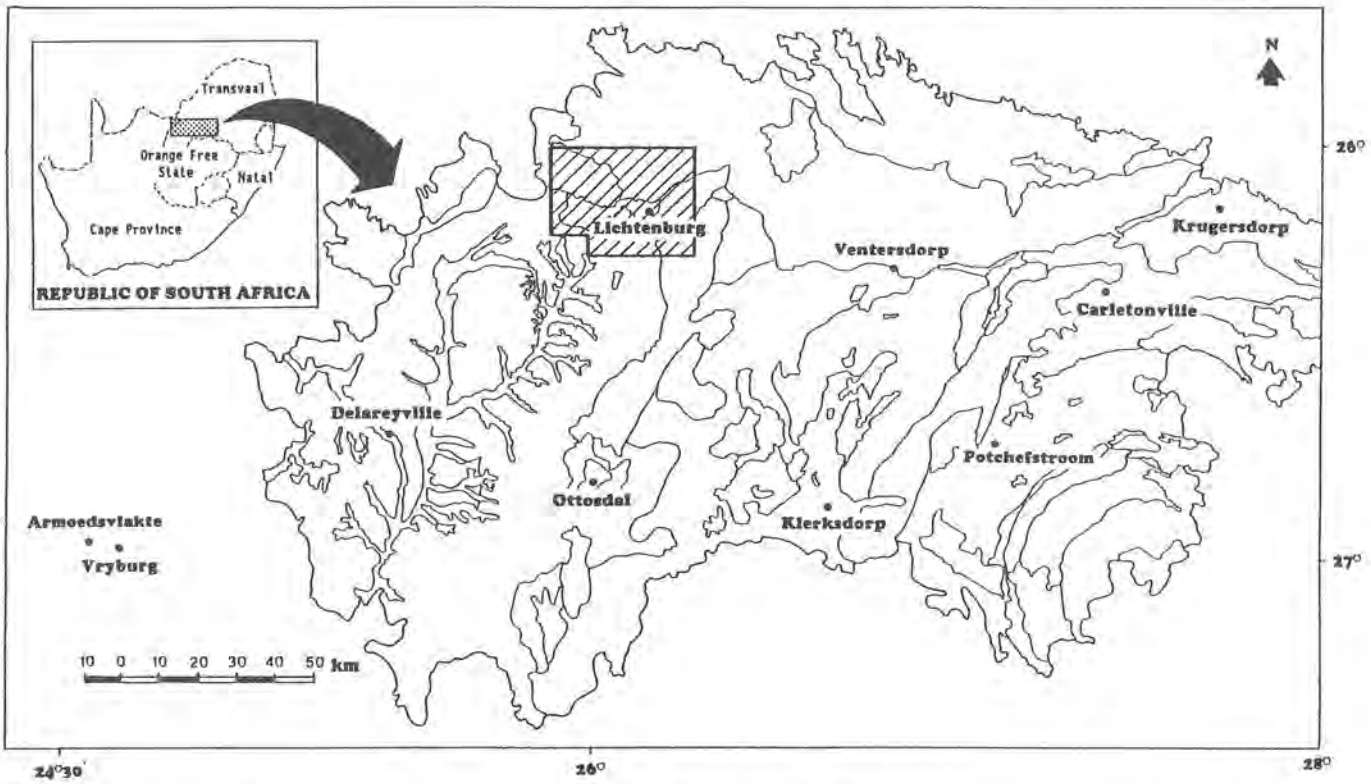


Figure 2 The location of the Morris study area (hatched) (Morris 1973) in the western Transvaal Grassland (Bezuidenhout, in prep.)

tion of the *Cymbopogon–Themeda* Grassland is the actual or potential dominance of *Themeda triandra* (Louw 1951). Low cover of *Themeda triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon plurinodis* and *Aristida congesta* is attributed to the grazing factor (Louw 1951).

The Braun-Blanquet hierarchical classification of these plant communities is:

1. *Aristida diffusa–Cymbopogon excavatus* Major Grassland (Table 1)
   - 1.1 *Stipagrostis uniplumis–Fingerhuthia africana* Grassland
     - 1.1.1 *Themeda triandra–Stipagrostis uniplumis* Variant
     - 1.1.2 *Diheteropogon amplectens–Stipagrostis uniplumis* Variant
     - 1.1.3 *Salvia radula–Stipagrostis uniplumis* Variant
   - 1.2 *Diplachne fusca–Cymbopogon excavatus* Grassland
     - 1.2.1 *Cymbopogon plurinodis–Diplachne fusca* Variant
     - 1.2.2 *Eragrostis racemosa–Diplachne fusca* Variant
     - 1.2.3 *Anthephora pubescens–Diplachne fusca* Variant
2. *Themeda triandra–Eragrostis superba* Major Grassland (Table 2)
   - 2.1 *Elionurus muticus–Heteropogon contortus* Grassland
     - 2.1.1 *Aristida canescens–Elionurus muticus* Grassland
       - 2.1.1.1 *Eragrostis stapfii–Aristida canescens* Variant
       - 2.1.1.2 *Cymbopogon plurinodis–Aristida canescens* Variant
     - 2.1.2 *Brachiaria serata–Diplachne fusca* Grassland
       - 2.1.2.1 *Anthephora pubescens–Diplachne fusca* Variant
       - 2.1.2.2 *Heteropogon contortus–Diplachne fusca* Variant
   - 2.2 *Panicum coloratum–Sporobolus africanus* Grassland and Woodland
     - 2.2.1 *Sporobolus africanus–Cymbopogon plurinodis* Grassland
     - 2.2.2 *Cynodon dactylon–Acacia karroo* Woodland

Description of the plant communities

1. *Aristida diffusa–Cymbopogon excavatus* Major Grassland (Table 1)

This community relates to groups 4b, 5b and 8 (Morris 1973) (Table 3).

This Major Grassland community mostly occurs on the flat plains, on surface limestone or on lava conglomerate, and quartzite of the Ventersdorp Supergroup.

The diagnostic species are *Aristida diffusa* and *Cymbopogon excavatus* (species group A, Table 1), which are mostly absent in the *Themeda triandra–Eragrostis superba* Major Grassland (Community 2, Table 2).

Various communities were identified in this Grassland. Constantly present, prominent species in all these communities are the grasses *Elionurus muticus*, *Themeda triandra*, *Heteropogon contortus*, *Eragrostis curvula*, *Setaria sphacelata*, *Brachiaria serrata* and *Triraphis andropogonoides*. The most abundantly present or conspicuous Grassland-associated forbs include *Barleria macrostegia*, *Vernonia oligocephala*, *Dicoma anomala*, *Helichrysum caespititium*, *Crabbea angustifolia*, *Anthospermum rigidum* and *Justicia anagalloides*.

1.1 *Stipagrostis uniplumis–Fingerhuthia africana* Grassland

This community relates to group 4b (Morris 1973) (Table 3).

The *Stipagrostis uniplumis–Fingerhuthia africana* Grassland occurs on flat plains with shallow (0.025 – >0.3 m) aeolian sands overlying surface limestone. The calcareous soils are often slightly alkaline with a pH of 7.5.

This community is characterized by species group B (Table 1)

Table 1 A phytosociological table of the *Aristida diffusa–Cymbopogon excavatus* Major Grassland from the *Cymbopogon–Themeda* Grassland, Lichtenburg area

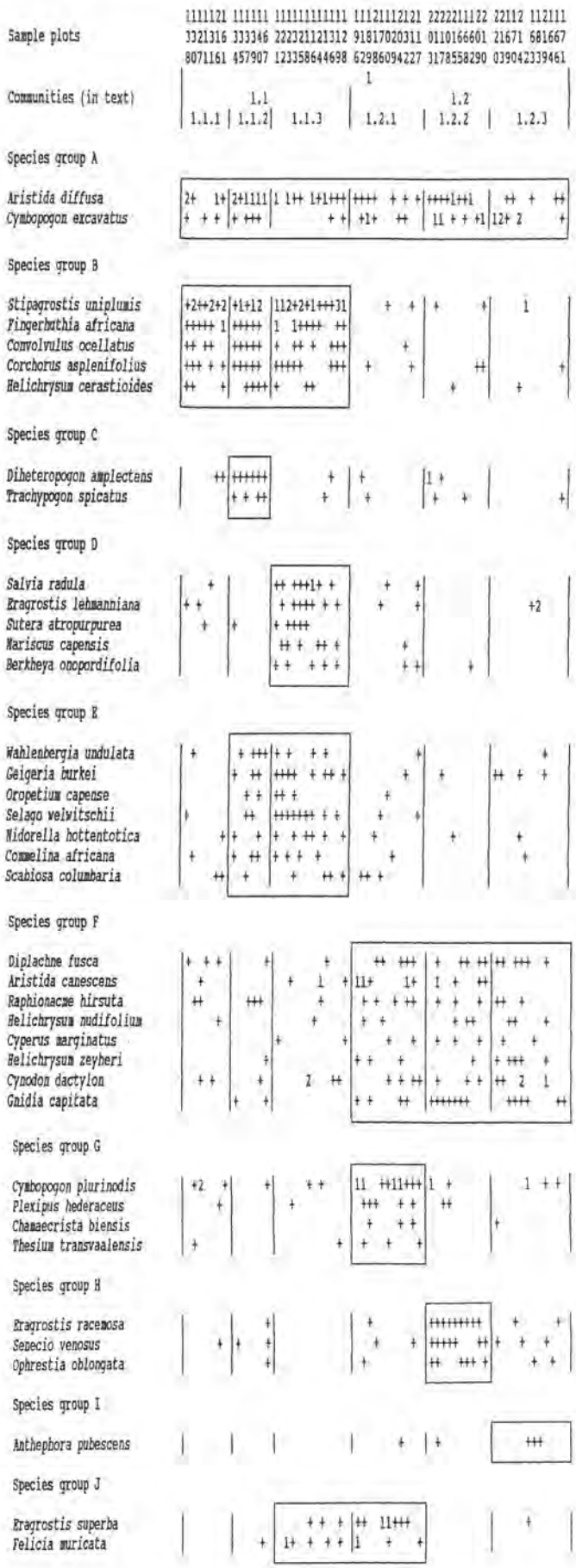
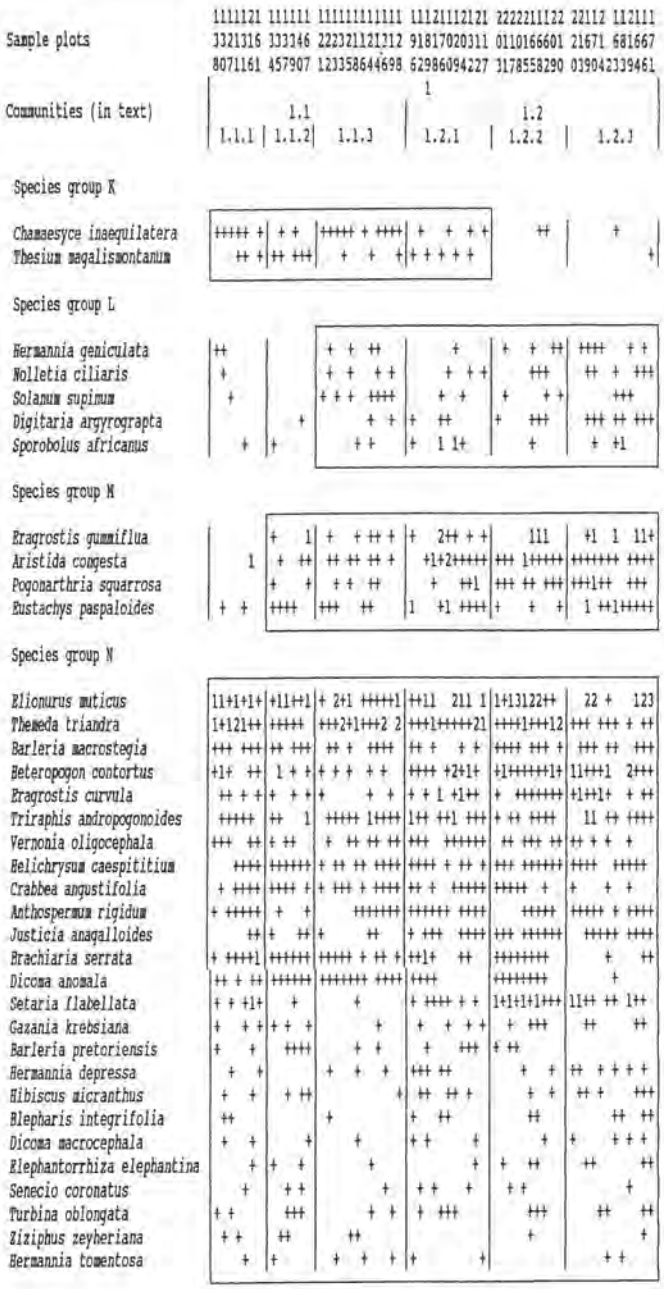


Table 1 Continued



and the diagnostic species include the grasses *Stipagrostis uniplumis* and *Fingerhuthia africana* and forbs *Convolvulus ocellatus* var. *ornatus*, *Helichrysum cerastioides* and *Corchorus asplenifolius*.

In all three recognized Variants the most prominent grass species are *Themeda triandra*, *Elionurus muticus* and *Stipagrostis uniplumis* (Table 1).

1.1.1 *Themeda triandra–Stipagrostis uniplumis* Variant

Most relevés of this Variant are from group 4b (Morris 1973) (Table 3).

Within the plains of the *Stipagrostis uniplumis–Fingerhuthia africana* Grassland, this Variant is restricted to localities with deeper than 0.3 m sandy soils.

No diagnostic species could be identified but the Variant is characterized by the absence of species groups C and D, and the absence of species groups E and M is also a conspicuous feature of this Variant (Table 1).

Table 2 A phytosociological table of the *Themeda triandra–Eragrostis superba* Major Grassland from the *Cymbopogon–Themeda* Grassland, Lichtenburg area

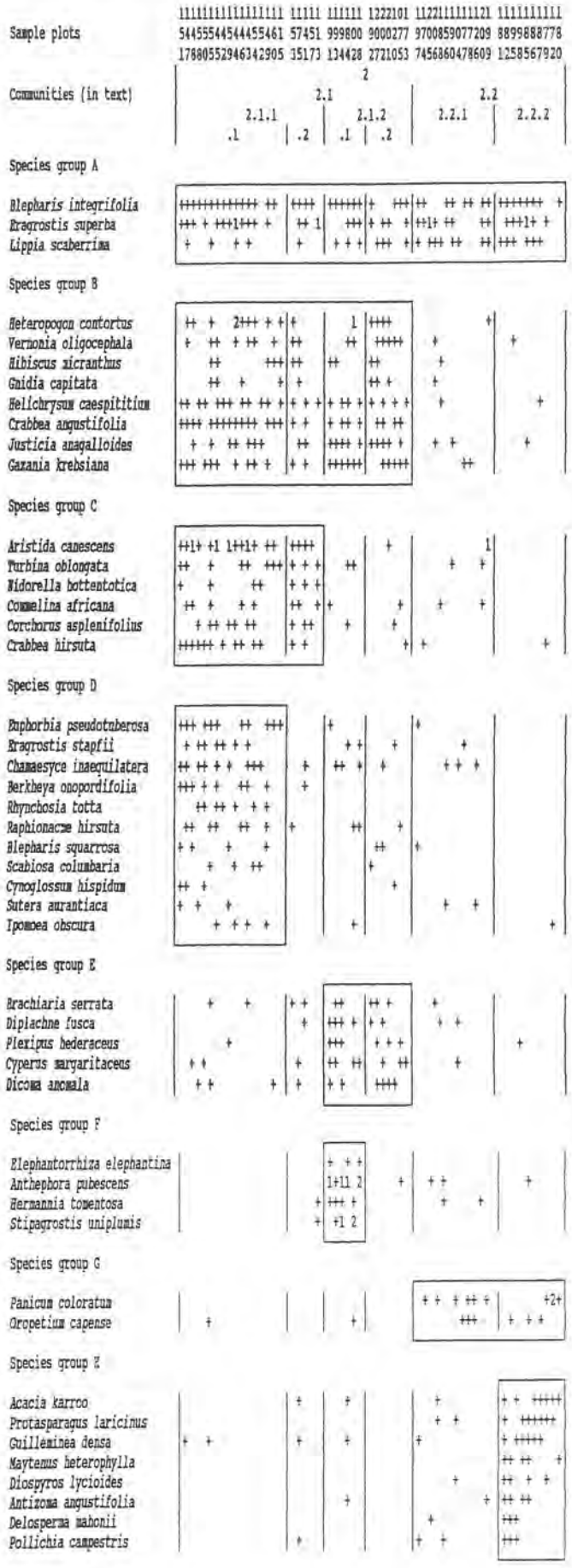
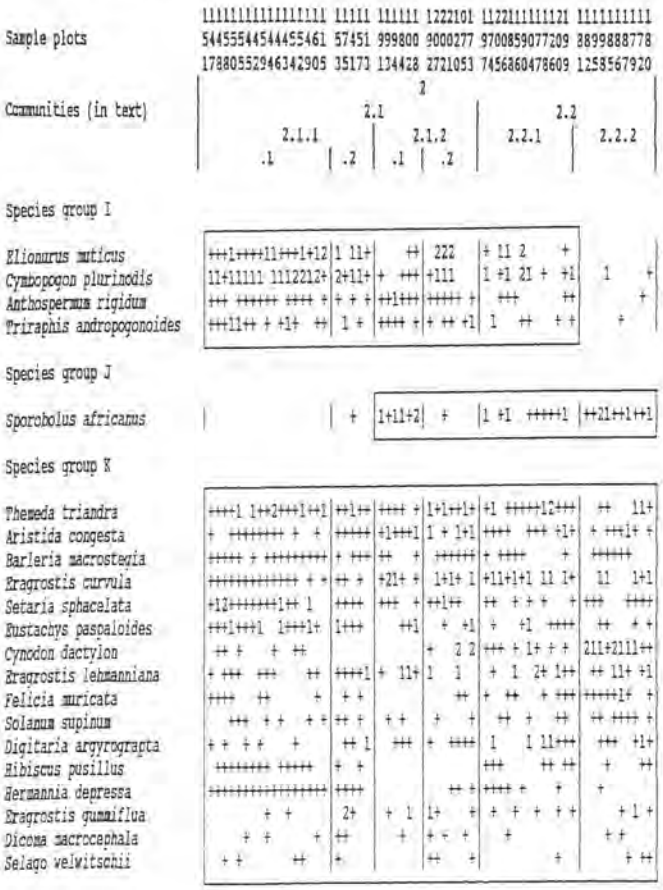


Table 2 Continued



1.1.2 *Diheteropogon amplectens–Stipagrostis uniplumis* Variant

Most relevés of this Variant are from group 4b (Morris 1973) (Table 3).

This Variant occurs on very shallow (0.025–0.1 m) rocky soils with *Diheteropogon amplectens* and *Trachypogon spicatus* (species group C, Table 1) as diagnostic species.

1.1.3 *Salvia radula–Stipagrostis uniplunis* Variant

This Variant relates to groups 4b and 6a (Morris 1973) (Table 3).

This Variant occurs on deeper (0.3–0.5 m) and slightly more clayey soils in local depressions in the extensive flat Grassland plains.

The vegetation is characterized by species group D (Table 1) which includes the grass *Eragrostis lehmanniana* and the forbs *Salvia radula, Sutera atropurpurea, Mariscus capensis* and *Berkheya onopordifolia*. These diagnostic forb species are associated with the periodically flooded bottomland areas (Bredenkamp & Bezuidenhout 1990).

1.2 *Diplachne fusca–Cymbopogon excavatus* Grassland

This Grassland community relates to groups 5b and 8 (Morris 1973) (Table 3).

The *Diplachne fusca–Cymbopogon excavatus* Grassland occurs on the extensive plains or gentle waxing slopes on conglomerate, lava or quartzites of the Ventersdorp Supergroup. The acid (pH = 6.5) soil is deep (>0.6 – 1.0 m), not calcareous and represents the Avalon form (Soetmelkvlei series).

The community is characterized by species group F (Table 1) and the diagnostic species are the grasses *Diplachne fusca, Aristida canescens* and *Cynodon dactylon* and the forbs *Raphionacme hirsuta, Helichrysum nudifolium, Helichrysum zeyheri,*

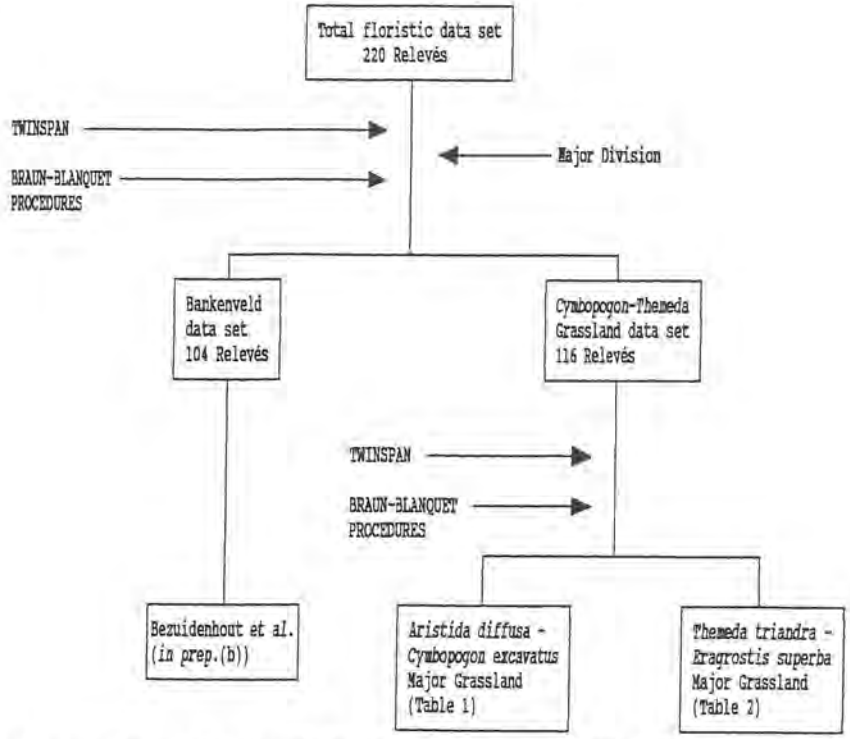


Figure 3 A dendrogram to illustrate the major division of the total floristic data set (Morris 1973) as well as the division of the *Cymbopogon–Themeda* Grassland data set into two Major Grasslands.

Table 3 A comparison between the *Cymbopogon–Themeda* Grassland total Association Analysis and the Braun-Blanquet classification

Association Analysis	Braun-Blanquet classification												
	1.1.1	1.1.2	1.1.3	1.2.1	1.2.2	1.2.3	2.1.1.1	2.1.1.2	2.1.2.1	2.1.2.2	2.2.1	2.2.2	Total
4a						1							1
4b	5	5	9		1				1				21
5a		1											1
5b	1			6	6	2	1	1	1	3			21
6a	1		3	1									5
6b								1	1		1		3
7a							13	1		1			15
7b							2	1					3
7c				3					2	2			7
8				1	2	5	1				1		10
9a				1		1	1	2	1	1	4	1	12
9b											5	5	10
9c						1					2	4	7
Total	7	6	12	11	10	12	17	5	6	7	13	10	116

Gnidia capitata and the sedge *Cyperus marginatus*.

The most prominent species are *Elionurus muticus* and *Heteropogon contortus*, with *Cymbopogon excavatus* and *Setaria sphacelata* locally prominent (Table 1).

1.2.1 *Cymbopogon plurinodis–Diplachne fusca* Variant

Most relevés of this Variant are from group 5b and to a lesser extent also from group 7c (Morris 1973) (Table 3).

The habitat is mostly the flat plains with acid soils, not calcareous, of the Avalon form (Soetmelksvlei series).

The Variant is characterized by species group G (Table 1), which includes the grass *Cymbopogon plurinodis* and the forbs *Plexipus hederaceus, Thesium transvaalensis* and *Chamaecrista biensis* as diagnostic species.

The most prominent grass species are *Elionurus muticus, Cymbopogon plurinodis, Heteropogon contortus, Eustachys pas-*

paloides and *Themeda triandra*. Pioneer species such as *Cynodon dactylon*, *Aristida congesta* and *Felicia muricata* are conspicuous on locally overgrazed sites.

1.2.2 *Eragrostis racemosa–Diplachne fusca* Variant

This Variant mainly relates to group 8 and to a lesser degree also to group 5b (Morris 1973) (Table 3).

The habitat consists mostly of waxing slopes on slightly shallower soils than on the plains.

The Variant is characterized by species group H (Table 1), which includes the grass *Eragrostis racemosa* and the forbs *Senecio venosus* and *Ophrestia oblongata* as diagnostic species.

The dominant grass species is *Elionurus muticus* with the grasses *Setaria sphacelata*, *Heteropogon contortus*, *Aristida congesta* and *Themeda triandra* also prominently present.

1.2.3 *Anthephora pubescens–Diplachne fusca* Variant

This Variant relates to group 8 (Morris 1973) (Table 3).

The soils of this Variant are mostly deep (0.6 – >1.0 m) and sandy, distinguishing the habitat of this Variant from the other two Variants (1.2.1 and 1.2.2) in the *Diplachne fusca–Cymbopogon excavatus* Grassland.

The Variant is characterized by species group I (Table 1), with the grass *Anthephora pubescens* as the only diagnostic species.

The most prominent grass species are *Setaria sphacelata*, *Heteropogon contortus*, *Eragrostis curvula* and *Eustachys paspaloides* (Table 1).

2. *Themeda triandra–Eragrostis superba* Major Grassland (Table 2)

This Major community relates to groups 6b, 7a and 9 (9a, 9b and 9c) (Morris 1973) (Table 3).

The *Themeda triandra–Eragrostis superba* Major Grassland is restricted to deeper and often clayey soils originated from Dwyka tillite, or may occur in bottomland situations with clayey soils.

The Grassland is characterized by species group A (Table 2), which includes as the diagnostic species the grass *Eragrostis superba* and the forbs *Blepharis integrifolia* and *Lippia scaberrima*. These species have a linked occurrence in the *Aristida diffusa–Cymbopogon excavatus* Major Grassland (Community 1, Table 1).

Various communities were identified in this Major Grassland. In all these communities, the grass species *Themeda triandra*, *Aristida congesta*, *Eragrostis curvula*, *Setaria sphacelata*, *Eustachys paspaloides*, *Eragrostis lehmanniana* and *Digitaria argyrograpta* are prominently present (Table 2).

The most constantly present Grassland-associated forbs include *Barleria macrostegia*, *Felicia muricata*, *Solanum supinum*, *Hibiscus pusillus* and *Hermannia depressa* (Table 2).

2.1 *Elionurus muticus–Heteropogon contortus* Grassland

This Grassland relates to group 6b but more prominently 7a and 7c (Morris 1973) (Table 3).

It is mostly restricted to deep (0.8–1.0 m) alkaline soils of the Avalon form (Soetmelkvlei series) which occurs on the plains on Dwyka tillite.

The Grassland is characterized by species group B (Table 2), with the grass *Heteropogon contortus* and the forbs *Vernonia oligocephala*, *Gnidia capitata*, *Helichrysum caespititium*, *Crabbea angustifolia*, *Hibiscus micranthus*, *Justicia anagalloides* and *Gazania krebsiana* as the diagnostic species.

The dominant grass species are *Elionurus muticus* and *Cymbopogon plurinodis* and other conspicuous grasses include *Triraphis andropogonoides*, *Eragrostis superba*, *Themeda triandra*, *Aristida congesta*, *Eragrostis curvula*, *Setaria sphacelata* and *Eustachys paspaloides* (Table 2).

Two communities, each with two Variants, were recognized in this community (Table 2).

2.1.1 *Aristida canescens–Elionurus muticus* Grassland

This Grassland relates well to group 7a (Morris 1973) (Table 3).

It is mostly restricted to deep (1.0 m) alkaline soils of the Avalon form (Soetmelkvlei series) which occurs on the plains on Dwyka tillite.

The Grassland is characterized by species group C (Table 2), with the grass *Aristida canescens* and the forbs *Turbina oblongata*, *Nidorella hottentotica*, *Commelina africana*, *Corchorus asplenifolius* and *Crabbea hirsuta* as the diagnostic species.

The dominant grass species are *Elionurus muticus* and *Cymbopogon plurinodis*, and other conspicuous species include *Triraphis andropogonoides*, *Eragrostis superba*, *Themeda triandra*, *Aristida congesta*, *Eragrostis curvula*, *Setaria sphacelata* and *Eustachys paspaloides* (Table 2).

Two Variants were recognized in this community (Table 2).

2.1.1.1 *Eragrostis stapfii–Aristida canescens* Variant

This Variant relates to group 7a (Morris 1973) (Table 3).

It is the most typical of the *Aristida canescens–Elionurus muticus* Grassland and occurs on similar habitat.

It is further characterized by species group D (Table 2), with the grass *Eragrostis stapfii* and the forbs *Raphionacme hirsuta*, *Blepharis squarrosa*, *Scabiosa columbaria*, *Euphorbia pseudotuberosa*, *Chamaesyce inaequilatera*, *Berkheya onopordifolia*, *Rhynchosia totta*, *Cynoglossum hispidum*, *Sutera aurantiaca* and *Ipomoea obscura* as the diagnostic species.

2.1.1.2 *Cymbopogon plurinodis - Aristida canescens* Variant

The relevés of this Variant are scattered amongst groups 5b, 6b, 7a and 9a (Morris 1973) (Table 3), and cannot be related to any particular group.

The habitat is similar to that of the *Aristida canescens–Elionurus muticus* Grassland.

The Variant is characterized by the absence of species group D (Table 2).

The most prominent species are the grasses *Elionurus muticus* and *Cymbopogon plurinodis* (Table 2).

2.1.2 *Brachiaria serrata–Diplachne fusca* Grassland

This Grassland relates to groups 5b and 7c (Morris 1973) (Table 3).

The habitat is heterogeneous, and mostly occurs on moderately deep (0.15–0.8 m), acid to neutral soils derived from Ventersdorp lava and quartzite of the Ventersdorp Supergroup.

This Grassland is characterized by species group E (Table 2), with the grasses *Diplachne fusca* and *Brachiaria serrata* and the forbs *Plexipus hederaceus*, *Cyperus margaritaceus* and *Dicoma anomala* as the diagnostic species.

The dominant grass species are *Elionurus muticus* and *Cymbopogon plurinodis*, *Eragrostis curvula* and *Themeda triandra* (Table 2).

Two Variants were recognized in this community (Table 2).

2.1.2.1 *Anthephora pubescens–Diplachne fusca* Variant

The relevés of this Variant are scattered amongst groups 4b, 5b, 6b, 7c and 9a (Morris 1973) (Table 3) and cannot be related to any particular group.

This Variant occurs on localities with deep sandy acid or neutral soils within the *Brachiaria serrata–Diplachne fusca* Grassland.

It is characterized by species group F (Table 2). The diagnostic species for this Variant are the grasses *Anthephora pubescens* and *Stipagrostis uniplumis* and the forbs *Hermannia tomentosa* and *Elephantorrhiza elephantina*. All these species are usually restricted to deep sandy soils (Bezuidenhout, in prep.).

The prominent species are the grasses *Anthephora pubescens* and *Sporobolus africanus* (Table 2).

2.1.2.2 *Heteropogon contortus–Diplachne fusca* Variant

This Variant relates mainly to groups 5b and 7c (Morris 1973) (Table 3).

It is the most typical of the *Aristida canescens–Elionurus muticus* Grassland and is mostly restricted to moderately deep (0.5–0.8 m) acid clayey soils derived from rocks of the Ventersdorp Supergroup.

The Variant is characterized by the absence of species groups F and G (Table 2).

The prominent species are the grasses *Elionurus muticus*, *Themeda triandra* and *Cymbopogon plurinodis* (Table 2).

2.2 *Panicum coloratum–Sporobolus africanus* Grassland and Woodland

This vegetation relates well to group 9 (Morris 1973) (Table 3).

The *Panicum coloratum–Sporobolus africanus* Grassland and Woodland is mostly restricted to deep (0.3–0.9 m), clayey soils which occur on the plains or bottomland drainage lines of the Ventersdorp quartzite and lava or Dwyka tillite.

The community is characterized by species group G (Table 2), with the grasses *Panicum coloratum* and *Oropetium capense* as diagnostic species.

The dominant grass species are *Sporobolus africanus* and *Themeda triandra* (Table 2).

Two communities were recognized (Table 2).

2.2.1 *Sporobolus africanus–Cymbopogon plurinodis* Grassland

The relevés are scattered amongst groups 9a, 9b and 9c (Morris 1973) (Table 3).

The *Sporobolus africanus–Cymbopogon plurinodis* Grassland is mostly restricted to deep (0.3–0.9 m), clayey soils which occur on the plains of the Ventersdorp quartzite and lava or Dwyka tillite.

Although no diagnostic species occur, this vegetation is recognized by the presence of species group I (Table 2), which includes *Elionurus muticus*, *Cymbopogon plurinodis*, *Anthospermum rigidum* and *Triraphis andropogonoides* showing the affinity of this Grassland to the *Elionurus muticus–Heteropogon contortus* Grassland (community 2.1) as well as species groups G (diagnostic for *Panicum coloratum–Sporobolus africanus* Grassland and Woodland) and J.

The most prominent grasses are *Panicum coloratura*, *Cymbopogon plurinodis*, *Sporobolus africanus*, *Themeda triandra* and *Eragrostis curvula* as prominent species.

2.2.2 *Cynodon dactylon–Acacia karroo* Woodland

This woodland relates to groups 9b and 9c (Morris 1973) (Table 3).

The *Cynodon dactylon–Acacia karroo* Woodland is mostly restricted to deep (0.3–0.9 m), clayey soils which occur in the bottomlands of the Ventersdorp quartzite and lava or Dwyka tillite.

This Woodland is characterized by species group H (Table 2) with the woody species *Acacia karroo*, *Maytenus heterophylla* and *Diospyros lycioides*, the shrubby species *Protasparagus laricinus* and *Pollichia campestris*, and the forbs *Guilleminea densa*, *Antizoma angustifolia*, *Delosperma mahonii* and *Solanum supinum* being diagnostic.

The most common tree, *Acacia karroo*, can attain a height of up to 6 m. The most prominent shrubs are *Maytenus heterophylla* and *Diospyros lycioides* and the dominant grasses are *Sporobolus africanus*, *Cynodon dactylon* and *Eragrostis lehmanniana* (Table 2). This Woodland shows similarities with *Acacia karroo* Woodlands described by Bezuidenhout and Bredenkamp (1991) and Bezuidenhout *et al.* (1994) from other parts of the western Transvaal.

B. Comparison of Association Analysis and Braun-Blanquet classifications

The dendrogram produced by the Association Analysis of the vegetation is given in Figure 1. The allocation of relevés from the Association Analysis to the Braun-Blanquet plant communities is given in Table 3. The general structure of this table broadly confirms the subdivision of the *Cymbopogon–Themeda* Grassland vegetation into two Major Grassland communities. Association Analysis groups 4b, 5b, 6a, 7b and 8 mainly represent the *Aristida diffusa–Cymbopogon excavatus* Major Grassland (Community 1, Table 1), while groups 6b, 7a, 7c, 9a, 9b and 9c mainly represent the *Themeda triandra–Eragrostis superba* Major Grassland (Community 2, Table 2). The comparison between the Association Analysis and the Braun-Blanquet classification shows that 55 of the 116 relevés (47.4%) were classified in accordance with the *Cymbopogon–Themeda* Grassland Braun-Blanquet classification.

The results indicate that Association groups 4b, 5a and 6a represent the three easily recognizable and ecologically interpretable communities (1.1.1, 1.1.2 and 1.1.3 of the *Stipagrostis uniplumis–Fingerhuthia africana* Grassland). The relevés of group 5b are scattered amongst eight of the communities of the Braun-Blanquet classification, but together with group 8 mainly represent the *Diplachne fusca–Cymbopogon excavatus* Grassland (community 1.2), while groups 7b and 7c mainly relate to plant communities 1.2.3 and 1.2.1, respectively. Group 7c also relates to community 2.1.2. Group 6b cannot be reconciled with any of the communities identified by the Braun-Blanquet procedure. Group 9 mainly relates to the *Panicum coloratum–Sporobolus africanus* Grassland and Woodland (community 2.2).

Conclusion

Using Association Analysis, Morris (1973, 1976) identified 13 groups in the *Cymbopogon–Themeda* Grassland, but related only 9 of these groups to specific plant communities. Some of these communities are quite heterogeneous in floristic composition and habitat, and it is difficult to interpret them ecologically.

In the present study, a hierarchical classification is derived from the Braun-Blanquet analysis, revealing 12 communities or variants, variously grouped into larger more comprehensive vegetation units. Owing to limited habitat information provided by Morris (1973, 1976), it was difficult and sometimes impossible to relate all the presently described plant communities to specific habitat conditions. In spite of this limitation, it is clear that this classification of the Lichtenburg data should be reconcilable with other Braun-Blanquet type classifications of the Grassland Biome in the western Transvaal.

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